

INTRODUCTION

The *Montana Wind Energy Atlas* is a comprehensive analysis of wind energy data designed for use by individuals and organizations involved in wind energy development. It contains wind data that are representative of selected geographical areas across the state. This atlas represents the first time that Montana wind energy data held by numerous public and private entities have been collected, evaluated, and made available in a single volume. The *Atlas* should be a valuable reference for developers and engineers concerned with siting and construction of commercial-scale wind farms, as well as for individuals interested in smaller-scale installations.

The Department of Natural Resources and Conservation contracted with GeoResearch, Inc., of Billings to develop the *Atlas*. The first phase of its development involved a thorough survey of public and private agencies to determine the amount of Montana wind data available. Through this survey, GeoResearch established an extensive meteorological data base for the state; this base included wind speed, wind direction, and atmospheric stability data in hard copy or machine-readable form. The sets within the data base then were evaluated on the basis of length of record, similarity of data collection methods, adequacy of the data, and area for which the data are representative. With the aid of detailed computer programs, the usable data were subsequently analyzed and reduced to summary form for publication. This *Atlas* provides a wind energy profile for selected locations representative of the different geographical areas of the state. It does not summarize all historical data from all Montana wind monitoring sites.

The *Montana Wind Energy Atlas* is organized as follows:

- Chapter I: Introduction
- Chapter II: Wind Monitoring Programs in Montana
- Chapter III: Wind Energy Potential

- Chapter IV: Site-by-Site Wind Analyses
- Chapter V: Power Law Analyses

Chapter II is a discussion of wind energy measurement programs conducted in Montana. The information available from these programs is evaluated in terms of how well it represents a region, its overall quality, and the inter-site comparability of collection methods. A list of the more important monitoring sites is included, along with a map showing site locations, monitoring agencies, and durations of data collection.

Chapter III summarizes wind data analyses from a statewide perspective. Sites are ranked by wind energy potential. Detailed tables and generalized isopleth maps display average annual wind speed and average annual wind power.

Chapter IV presents a detailed site-by-site description and analysis of all sites included in the *Atlas*. For each site, the data collected are evaluated for the period of data coverage, the method of collection, and the quality of the data. Summaries of monthly and annual average wind speed and wind power density are presented.

For purposes of this *Atlas*, sites where the average annual wind speed is equal to or greater than 11 miles per hour are considered "high potential" sites. In the description of such sites, these additional data summaries are provided:

- Diurnal wind speed frequency distribution by season;
- Directional frequency and average speed (wind rose);
- Coefficients of the Weibull distribution.

Detailed descriptions of site characteristics also are presented for the high potential sites. These descriptions include information on current use of the site, availability of space for further development, ease of access, and proximity of the site to transmission lines, sensitive communications equipment, and aircraft corridors.

Additional data analyses for two sites — the Livingston Candidate Wind Turbine site and the

Montana Power Company Salem site — where wind speed data gathered at more than one height above ground level were available, are presented in Chapter V. Variations in wind speed with height were analyzed for these sites.

Four appendices are included in this *Atlas*. Appendix A describes wind measurement procedures in general. Appendix B describes the methods used to gather and analyze the data. Appendix C briefly discusses sites for which data analyses are not

presented. Appendix D is a bibliography listing wind energy resource information for Montana.

The *Atlas* was updated in 1987. It originally contained data available to DNRC as of the beginning of 1983. The updated version has information on nine additional sites, and larger term data on eleven sites in the first edition of the *Atlas*. Many of these sites are high potential sites. DNRC hopes to continue to update and expand the *Atlas* in the future.